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BY CAROL TENOPIR

Moving Toward Electronic Journals

PRINT STILL PREDOMINATES in journal publishing, but that role may soon fade. Too slowly or too quickly, steadily or in fits and starts (depending on your perspective and patience level), scholarly journals are moving toward reliance on digital forms. This is happening in part because librarians, scholars, and even some publishers are unhappy about the current state of print journals.

Critics complain of high prices, delays between writing and dissemination, and the limitations of the paper format in terms of length, distribution, and presentation of data. Still, journals remain the most important part of the scholarly communication process and that value must not be sacrificed in a digital world.

Donald W. King (the retired president of King Research, Inc.) and I recently examined how scholarly journals developed and how lessons from the past can influence a future dominated by electronic journals in our cowritten book, *Towards Electronic Journals: Realities for Scientists, Librarians, and Publishers* (Special Libraries Assn., 2000). Here are some of the findings.

Reading is important

While journals have flaws, hundreds of studies over the years have demonstrated their use, usefulness, and value. Many studies were performed in the 1960s and 1970s, but recent surveys confirm those findings.

In our surveys from 1993 to 1998, we found that scientists averaged 120 readings of scholarly articles per year. Three-quarters of readings by university scientists are for research purposes and over one-half of these readings are said to be essential. Two-fifths are for teaching purposes, with most considered essential.

Nonacademic scientists read less, but information is extremely important to their work. In both settings, scientists whose work has been recognized through achievement awards read more on average than non–award winners. A high proportion of readings are said to improve the quality of research and teaching, to help scientists do the work faster, and to save them time and money.

A series of surveys from 1977 to 1998 show that scientists have steadily increased their reading. A 1977 national survey done for the National Science Foundation showed that university scientists read an average of 150 articles a year; a 1993 university survey reported 188 readings. Scientists outside universities read 90 articles yearly in 1977; surveys in the 1990s reported 106 readings. Now, as stated above, the average for scientists of all types is about 120 readings per year.

Estimates of the reading time spent per article have increased from about 45 minutes per article to 52 minutes, perhaps because the average length of articles increased from 7.4 pages to 11.7 pages during this time. We currently estimate that the typical U.S.-published scientific article is read about 900 times over the years.

Speedy publishing?

Publishing delays frustrate authors and readers. In 1977, a national survey showed that long delays had improved, but there was still a ten-month publishing lag on average. (Psychology articles took 20 percent longer.) Delays increased again on average until the mid-1980s, partly because more articles were published per journal.

Since then, delays have decreased, in part thanks to increased use of electronic processes by publishers. Much of the remaining delay then and now is due to manuscript selection, refereeing, and editing. While some remain critical, most authors and readers agree these processes contribute to the usefulness and value of scholarly journals.

How important is speedy publication to scientists? We examined the reading of recently published articles in terms of their usefulness and value. About three-fourths of articles read in recently published journals are found by browsing. This reading, done to keep up with the literature, serves more for teaching purposes than for research.

Presumably, they would welcome speedier information, but most of their reading of older articles serves research, not teaching. The older information is rated higher in importance, and more time is spent reading as the age of articles increases. This indicates that speed is hardly the only important factor.

Studies over the years show that scientists mostly read currently published articles, but the number of readings of an article decreases over time. Very few electronic journals have been published over five years. When such journals become prevalent, scientists may neglect to search them for older articles or, when they do, may not be able to retrieve desired digital versions.

Since older articles tend to be used for research purposes and are found to be more useful and valuable than the recently published articles, the availability of back issues is vital when electronic journals become paramount.

Changing patterns

While evidence suggests that the amount of reading and the time spent reading have been relatively stable over the past 20 years, scientists have found articles in new ways and used new sources. Surveys from 1993 to 1998 show that scientists identify articles they read by browsing through journal issues or bound volumes (62% of readings); by online searches (12%); by having other persons alert them (11%); by using citations found in other articles or books (9%); or by other means such as current awareness services and printed indexes (6%).



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Scientists today use library subscriptions (print or electronic) for most readings; the rest use personal subscriptions and separate copies of articles. The proportion has changed dramatically since 1977; then only 15% of readings were from library subscriptions (vs. 55% now), 68% were from personal subscriptions (vs. 27% now), and 17 percent were from separate copies (vs. 18%).

The shift can be credited mostly to a decline in the number of personal subscriptions, coupled with better library services. In a given year scientists read at least one article from an average of 18 scholarly journals.

However, they tend to read only a few of those journals extensively. For example, across all journals read by scientists, only 5% are read more than 25 times by a scientist (on average) and about 80% are read fewer than ten times.

Said another way, about 14 of the 18 journals (that are read at least once) are read ten times or fewer; and only one journal is read more than 25 times. The volume of reading influences whether it should be purchased, depending, of course, on the cost of using alternative sources of the article such as document delivery or interlibrary loan.

Price matters

Price changes affect personal subscriptions the most. When scholarly journal prices began to escalate in the 1970s, the number of personal subscriptions began to drop. Over the past 20 years, the average number of personal subscriptions dropped from an estimated 5.8 subscriptions per scientist to 2.7 subscriptions (these were mostly subscriptions that are part of society membership). This circulation decline also lowered the proportion of reading from personal subscriptions.

As one would expect, few articles over five years old are found by browsing. Citations are the most frequent means of identifying older articles (about 36% of articles read), with online searches, other persons, and other means used about equally. Very few articles over five years old are read from copies of personal subscriptions (2%) or from other sources (4%). Rather, scientists rely on their library to obtain the older information (about 94% of these readings).

Separate copies

A substantial subterranean flow of separate article copies has flourished in the past 50 years. In 1977 scientists received 38 million copies of articles via preprints (two million), reprints (27 million), and photocopies given to users by interlibrary loan (four million), colleagues (3.5 million), and authors (1.5 million). The total increased to an estimated 47 million in 1984 and is now estimated at over 100 million.

The proportion of readings from separate copies of articles has not changed. However, reprint distribution has decreased, and interlibrary loan and document delivery together have increased ten-fold, from four million in 1977 to well over 40 million currently. This increase is due in large part to library subscription cancellations and improved interlibrary loan and document delivery services.

Journal literature is essential and transcends the medium that delivers it to users

The availability of separate copies of articles is essential to the scholarly journal system. It provides relatively inexpensive alternatives to journal subscriptions when a journal is read infrequently by scientists or library users. If the subscription cost (i.e., the cost per use) becomes too great, the purchaser can choose the separate copy alternative. On the other hand, if the cost of obtaining separate copies of the journal articles becomes too great, one can purchase the journal or ask the author or a colleague.

Clearly, online access to articles affects the journal system. However, a paper-based subscription may still cost less per reading (or be preferred for other reasons) compared to an electronic subscription or access to separate copies. Alternatively, electronic subscriptions may cost less (or are preferred), or separate copies may be preferable. Separate copies should not be seen as a replacement for subscriptions but as an alternative.

Not just black and white

Recent studies of academic scientists show that on average about half of university faculty now prefer electronic journals to paper. Librarians observe that students highly favor electronic journals.

While we tend to think in black and white terms—scholarly journals should be paper-based or electronic—the evidence suggests, at least in the short term, that electronic journals and digital full-text article databases will find a niche but not necessarily replace paper.

New pricing policies will undoubtedly influence that niche. Site licensing, differential pricing, and the new sources of revenue (particularly to cover fixed article processing costs) are needed for electronic publishing and digital databases to meet their full potential. Electronic journals and complementary digital databases introduce additional options from which scientists and libraries can choose.

Looking to the future

In the near-term future:

- New journals and journals serving small disciplines and audiences will tend to be exclusively electronic
- Established journals with large circulation will tend to be made available in both paper-based and electronic media. Subscribers (i.e., scientists, libraries) will choose one medium or the other depending on the extent of reading and personal preferences
- Access to separate copies of articles from digital full-text databases will replace and expand on current paper-based distribution

Research over the years continues to demonstrate that scientific journals have tremendous use, usefulness, and value. This will undoubtedly continue regardless of whether articles are published on paper or in digital formats.

Libraries face the challenge of providing a full range of journal access, in a range of media, a variety of pricing schemes, choices of full journals or separate articles, and from a broader array of commercial, nonprofit, or personal publishers. Journal literature is essential and transcends the medium that delivers it to users.

[Parts of this column are published in an article coauthored with Donald King in *Psycoloquy*, an electronic journal (www.princeton.edu/~harnad/psyc.html).]